

NOTE TO SPECIFIER: Use Conc. 28D in conjunction with Conc. 28 if there will be very severe sulfate attack. (See Concrete Manual table 2.)

c. Cementitious materials. -

(1) Portland cement. - Portland cement shall meet the requirements of ASTM designation: C 150 for type II or V cement, dependent upon which pozzolan is used, and shall meet the optional false-set limitation specified therein. Portland cement shall also conform to the low-alkali limitation, unless the Contractor selects aggregates which are not potentially alkali reactive as stated below.

(2) Pozzolan. - Pozzolan added at the jobsite or used in the manufacture of blended hydraulic cement shall meet the requirements of ASTM designation: C 618 for class N, F, or C with the following additional requirements:

(a) The maximum percent of sulfur trioxide shall be 4.0 percent for classes F and C.

(b) The maximum percent loss on ignition shall be 8.0 percent for class N and 2.5 percent for classes F and C.

(c) The pozzolanic activity index with lime shall be determined using 2-inch cubes, and the minimum strength at 7 days shall be 900 pounds per square inch.

(d) Unless the Contractor selects aggregates which are not potentially alkali reactive, pozzolan used under the options specified in subparagraphs b.(1) and (2) above shall be tested for reduction of mortar expansion at 14 days as specified for class N pozzolan under the optional physical requirements in table 2A of ASTM designation: C 618. However, the cement used in the test shall be low alkali. For the pozzolan to be acceptable, it shall result in an expansion reduction of zero percent or greater when compared to the control test.

Furthermore, pozzolan used shall significantly increase the sulfate resistance of concrete. The following class N pozzolans have been found to significantly increase sulfate resistance and either of them may be used:

(a) "Lassenite SR" pozzolan, as marketed by Lassenite Industries, Inc., 1475 Terminal Way, Reno NV 89502, from plant located near Herlong, California.

(b) "Sun" pozzolan, as produced by Oregon Portland Cement Co., 111 SE. Madison, Portland OR 97214, from plant located near Lime, Oregon.

Bureau of Reclamation research on class F and C pozzolans has correlated sulfate resistance to a resistance factor "R." "R" is defined as  $(C-5)/F$  where "C" is the calcium oxide content of the pozzolan in percent and "F" is the ferric oxide content in percent. The higher the "R" factor, the lower the sulfate resistance expected for concrete

containing the pozzolan. The "R" factor of class F or C pozzolan shall be less than 1.5 when used with type V cement or when used in blended cement containing clinker with not more than 5.0 percent  $C_3A$ . The "R" value of class F or C pozzolan shall be less than 0.75 when used with type II cement or when used in type IP(MS) blended cement. Calcium and ferric oxide contents shall be determined in accordance with ASTM designation: C 114.

(3) Blended cement. - Blended cement shall meet the requirements of ASTM designation: C 595 for type IP(MS) portland pozzolan cement and shall meet the following constraints:

- (a) The optional false-set limitation specified in ASTM designation: C 150.
- (b) The physical requirement of ASTM designation: C 595 for mortar expansion of type P cement at 14 days, unless the Contractor selects aggregates which are not potentially alkali reactive as stated below.
- (c) The pozzolan constituent shall be between 15 and 25 weight percent of the portland pozzolan cement.
- (d) The amount of pozzolan in the finished cement shall not vary by more than plus or minus 3 weight percent of the finished cement from that stated by the Contractor in the information submitted to the Contracting Officer as required below.
- (e) Pozzolan used in blended cement shall meet the applicable requirements in subparagraph a.(2) above.

Cement and pozzolan may be obtained from a Government-tested bin approved for Government use, from a commercial bin not reserved exclusively for Government use, or from a prequalified producer, as described in appendixes A and B of the Department of the Army Regulation No. ER 1110-1-2002. If cement or pozzolan is shipped from a commercial bin, a manufacturer's certification that the material was tested during production or transfer in accordance with the reference specification, together with a report of the test results, shall be furnished at the time of shipment. Certifications and test reports shall be submitted for each lot of cement or pozzolan from which shipments are drawn and shall be delivered to the location designated by the Contracting Officer. The Contractor shall assure that shipments accepted and used are from only those bins for which proper certification and test reports have been received. Manufacturer's certification and test reports shall in no way relieve the Contractor of the responsibility for furnishing materials meeting specifications requirements. The Contractor shall be responsible for the accuracy and completeness of certifications and test reports furnished.

The low-alkali limitation for portland cement and the mortar expansion requirement for pozzolan and blended cement may be waived if the Contractor selects concrete aggregate sources which have previously been tested by the Bureau of Reclamation and which, as

evidenced by petrographic examination or mortar bar tests, or both, do not contain potentially deleterious amounts of particles which may react with alkalis in cementitious materials. If available, information regarding the potential alkali reactivity of aggregate from a particular source may be obtained from the <sup>1</sup>[(Project) Construction Engineer,  
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If the potential alkali reactivity of an aggregate source is unknown, the low-alkali limitation and mortar expansion limit shall be met.

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<sup>1</sup>Revise as required and insert address of field office concerned.